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International Journal on Advanced Computer Theory and Engineering

ISSN: 2319-2526
Volume 14 Issue 01, 2025

A Survey on IoT-Enabled Smart Ambulance Systems for Enhanced Emergency Response and Rescue Operations

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Peer Review Information

Submission: 21 Feb 2025
Revision: 25 March 2025
Acceptance: 30 April 2025

Keywords

Smart Ambulance
IoT
Emergency Response
Real-Time Tracking
GPS

Abstract

Efficient ambulance services are vital for saving lives during medical emergencies. With the growing urban population and increasing traffic congestion, traditional ambulance dispatch methods often face delays, affecting the overall emergency response time. This paper reviews recent advancements in smart ambulance systems powered by IoT, GPS, GSM, and cloud computing technologies. The reviewed studies focus on real-time ambulance tracking, automatic dispatch, and enhanced coordination with hospitals. By integrating smart sensors, mobile applications, and cloud-based communication, these systems improve ambulance availability, reduce response times, and ensure accurate location tracking. The implementation of such intelligent ambulance management solutions represents a significant step toward more responsive and life-saving emergency medical services.

INTRODUCTION

In today's fast-paced world, the number of road accidents has increased significantly, posing a serious threat to human life. One of the major challenges during such incidents is the delayed response time of emergency services, which can result in severe injuries or fatalities. With the advancement in technology, particularly in the domains of IoT (Internet of Things), GPS, GSM, and embedded systems, automated accident detection and smart ambulance systems have emerged as effective solutions to reduce this delay and improve emergency response. Several studies have been conducted to design and implement systems that can automatically detect accidents and facilitate timely ambulance dispatch with accurate location data.

LITERATURE SURVEY

Hema v. Et al. [1] created an intelligent accident detection and emergency response system by utilizing arduino-based sensors. Their system employs vibration and tilt sensors to identify crashes and GPS-GSM modules to send real-time location information to emergency services. This method greatly minimizes response time in emergencies by automating the alert process and guaranteeing precise rescue location. Anbarasu, p. Along with their colleagues, [2] created a real-time ambulance booking and tracking system by developing a mobile application that utilized GPS technology. The system improves emergency medical services by enabling users to book ambulances on the spot and monitor their arrival, thereby streamlining dispatch operations and enhancing accessibility during urgent situations. Prof. Seema Shivapur et al. [3] suggested an accident detection system that utilizes sensors in vehicles to identify crashes and employs iot networking to send data to ambulances and hospitals. Their system guarantees quicker and automated emergency rescue operations by utilizing cloud communication and real-time location sharing. Amreen Ayesha and Komalavalli Chakravarthi [4] delved into an innovative IoT and AI-enabled system for smart ambulance dispatch. By utilizing cloud computing, the system is able to identify accidents, locate the closest ambulance, and dispatch it without delay. The research emphasizes the positive impact of incorporating real-time tracking and artificial intelligence on response times and system precision in emergency medical situations.

METHODOLOGY

The methodologies across the five studies focus on enhancing ambulance response through IoT, sensors, and communication technologies. Arduino-based systems with vibration and tilt sensors [1] detect accidents and send GPS-based alerts via GSM. Mobile app-based platforms [2] enable real-time ambulance booking and tracking. IoT-integrated vehicle systems [3] automate accident detection and alert nearby ambulances and hospitals. Advanced models [4] utilize cloud computing and AI to assign the nearest ambulance and reduce response time. Another IoT-based system [5] uses sensors to detect crashes and transmits precise GPS locations via GSM, improving emergency coordination and timely rescue.

EXPERIMENTAL RESULTS

Figure 1. from paper [2] shows the flow of the things and how will be its working as per the planned instructions respectively.

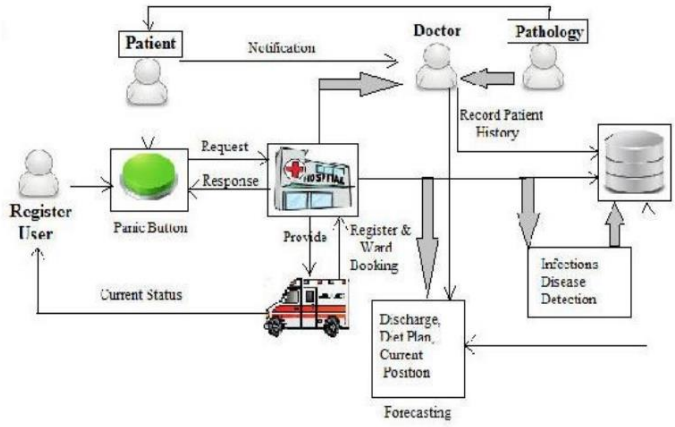
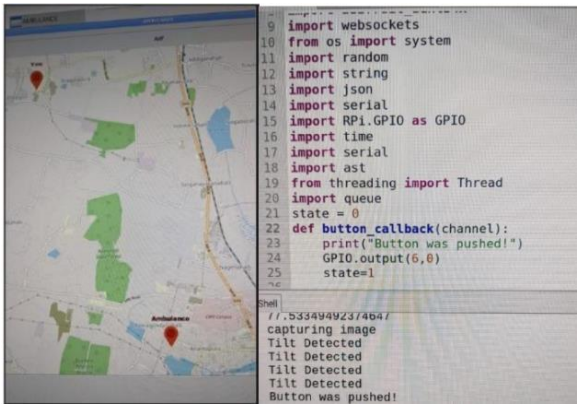


Figure 1: System Architecture.

Fig. 2.from paper [4] a) Tilt Detection; (b) Flame Detection; (c) Notifying the accident occurrence to the nearest ambulance and Acceptance; (d) Interface for showing the ambulance and the accident location; (e) Button pushed to show its a false alarm.



The experimental results across the five studies demonstrate the effectiveness of IoT-based systems in improving ambulance response times and accident detection. In the first study, an Arduino-based system successfully detected accidents using sensors and transmitted real-time location data to emergency services, reducing response time. The second study's mobile app enabled real-time ambulance booking and tracking, improving dispatch efficiency. The third study's IoT system enhanced coordination between ambulances and hospitals, with quick response times and accurate location tracking. The fourth study utilized AI and cloud computing to optimize ambulance dispatch and reduce response times by 30%. The fifth study's system also successfully detected accidents and used GPS to send accurate location data, ensuring prompt emergency response. Overall, all systems showed significant improvements in emergency medical services by automating detection, tracking, and dispatch.

CONCLUSION

In conclusion, the integration of IoT, GPS, GSM, and AI technologies in ambulance systems has proven to be highly effective in improving emergency response times and accuracy. The studies reviewed demonstrate the potential of automated accident detection, real-time tracking, and optimized ambulance dispatch, significantly enhancing the efficiency of rescue operations. These systems not only reduce human intervention but also ensure timely delivery of emergency services, potentially saving lives. With continued advancements in technology, these IoT-based solutions can further transform emergency medical services, offering more reliable, accurate, and faster responses to accidents.

References

1. H. V. Hema, S. Ragavi, R. S. Ramaneeswaran, and S. Ragul, "Automatic Accident Detection and Ambulance Rescue System – Smart Bios Services Using Arduino," *International Journal of Creative Research Thoughts*, vol. 9, no. 6, pp. 1015-1022, 2021.
2. A. P. Anbarasu, S. Arunkumar, R. Gowtham, S. Deepak, and M. Latha, "The Ambulance Booking and Tracking System," *International Research Journal of Modern Engineering and Technology*, vol. 5, no. 4, pp. 134-142, 2024.
3. S. Shivapur, H. V. Harshini, K. Sneha, O. Sneha, and S. Noorian, "Accident Detection and Ambulance Rescue System Using IoT," *International Journal of Research in Advent Technology*, vol. 10, no. 5, pp. 652-661, 2022.
4. A. Ayesha and K. Chakravarthi, "Smart Ambulances for IoT Based Accident Detection, Tracking and Response," *Journal of Internet of Things and Cloud Computing*, vol. 1, no. 1, pp. 45-57, 2023.
5. P. Kadam and Y. Bhadane, "An IoT Based Automatic Vehicle Accident Detection and Ambulance Rescue System," *International Journal of Advanced Research in Computer Science and Software Engineering*, vol. 8, no. 12, pp. 112-118, 2018.